ECE 530 Cloud Computing

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Datacenters and Supercomputers

Then the Web got REALLY big, and really important

Server PCs had to live in expensive data center

Microsoft Data Center in Dublin, 27,000 m^2, 22 MW, US$ 500 M

Infrastructure (Mega Datacenters)

Challenges: Agility, Green, and Smart Growth

Data Centers

- Need lots of electric power (1.5% of all US electricity, EPA 2007)
- Long lead time to build
- Inflexible investment of capital
- Need specialized skills (security, failover, load balancing, etc.)
- Takes time away from core competencies
- Hard for all but largest companies to own/run

Supercomputer

- What is a “Supercomputer”?
  - A *collective computing system* that provides processing capability exceeding that of any system ever built.
- Processing capability
  - Ability to quickly perform calculations
  - Ability to collect and process tremendous amounts of data
  - Unique ability to solve computationally challenging problems

Example of a Supercomputer
NASA SGI Columbia System

NASA Columbia

- 10,160 processors
- Infiniband interconnection network
- 1 Terabyte total memory
- ***1 TB/sec memory bandwidth***
- 51 Teraflops performance

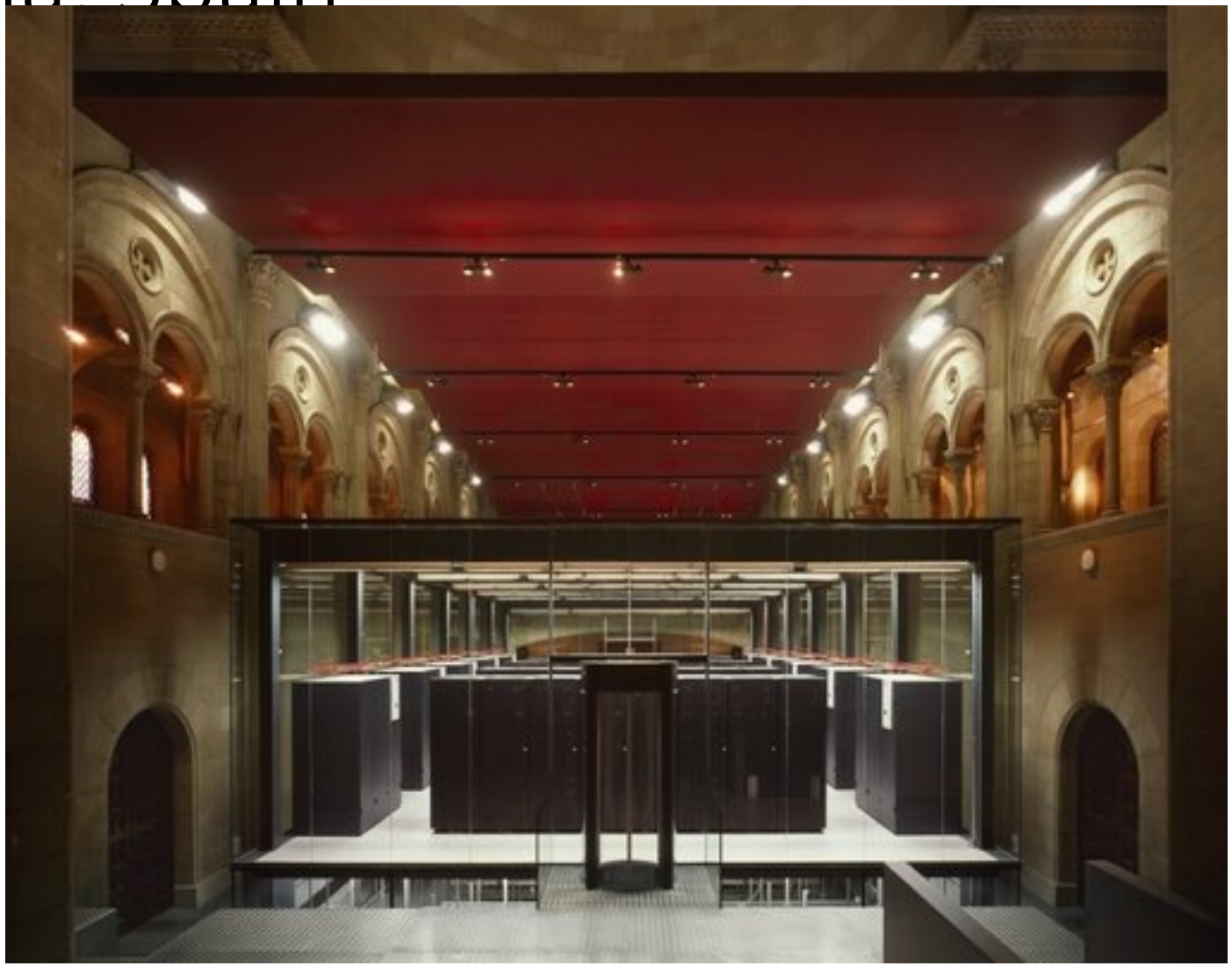
- Named in honor of the crew of the Columbia flight STS-107, lost February 2003

IBM Roadrunner at LANL

IBM Roadrunnner

- 2nd fastest supercomputer in the world
- First built in 2008
- 1.38 Petaflops/sec peak performance
- 24,480 processors
  - 12,240 IBM PowerXCell 8i processors
  - 12,240 AMD Opteron cores
- 4 GB of memory per node, 3060 nodes
  - 12 TB RAM

MareNostrum
Barcelona, Spain



MareNostrum

Manufacturer:	IBM BladeCenter
Cores:	48,896
Linpack Performance (Rmax)	925.1 TFlop/s
Theoretical Peak (Rpeak)	1,017.0 TFlop/s
Power:	1,015.60 kW
Memory:	
Interconnect:	Infiniband FDR
Operating System:	Linux

MareNostrum Interconnection Network

Fastest: Tianhe-2

Tianhe-2 (MilkyWay-2) - TH-IVB-FEP Cluster, Intel Xeon E5-2692 12C 2.200GHz, TH Express-2, Intel Xeon Phi 31S1P

Site:	National Super Computer Center in Guangzhou
Manufacturer:	NUDT
Cores:	3,120,000
Linpack Performance (Rmax)	33,862.7 TFlop/s
Theoretical Peak (Rpeak)	54,902.4 TFlop/s
Power:	17,808.00 kW
Memory:	1,024,000 GB
Interconnect:	TH Express-2
Operating System:	Kylin Linux
Compiler:	icc
Math Library:	Intel MKL-11.0.0
MPI:	MPICH2 with a customized GLEX channel